(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 425 789 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **90116622.3**

(51) Int. Cl.5: **B28D 1/12**

(22) Date of filing: **30.08.90**

(30) Priority: **31.10.89 JP 127327/89**

(43) Date of publication of application: **08.05.91 Bulletin 91/19**

(84) Designated Contracting States: **BE CH DE FR GB LI**

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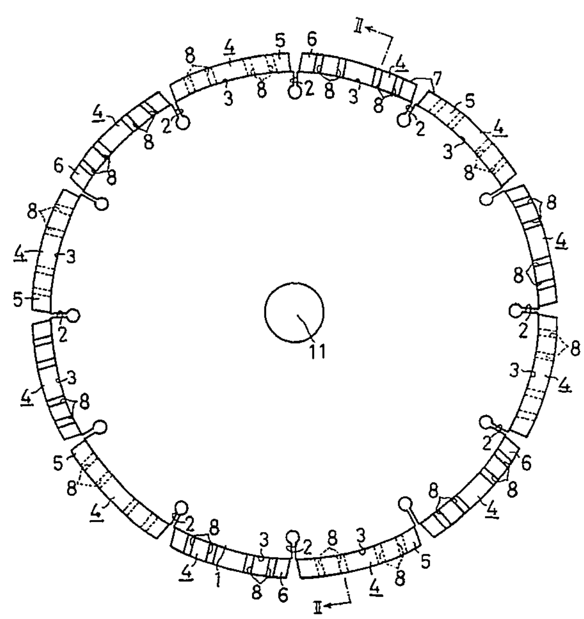
(54) Rotary cutting blade.

(57) A rotary cutting blade having an improved cutting tooth structure is provided. A plurality of abrasive impregnated cutting teeth are secured to the circumferential surface of a blade body. Each cutting tooth has a substantially arcuate outer peripheral surface with a leading cutting edge. A first side surface of each tooth is substantially flat while an opposing second side surface has a plurality of grooves cut into the tooth. The grooves are arranged to intersect the tooth's peripheral surface. Thus, the grooves cooperate with the leading edge to provide a plurality of cutting surfaces on each tooth. The teeth are then arranged successively along the circumferential surface of the blade such that their respective grooved surfaces alternately face in opposing directions.

Fig.1



EP 0 425 789 A2

ROTARY CUTTING BLADE

This application claims the priority of Japanese Patent Application No. 1-127327 filed October 31, 1989, which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to rotary saw blades suitable for cutting concrete, tile, stone and the like. More particularly, an improved cutting tooth design and arrangement is disclosed.

2. Description of the Related Art

Rotary saw blades are generally known. Representative prior art blades are shown in Figures 10 and 11. Such saw blades may include a disc shaped blade body 21 having a plurality of notches 22 cut into its circumferential surface at substantially equal intervals, thus forming lands 23 in the regions between adjacent notches. The cutting teeth 24 are typically specially fabricated with a diamond powder abrasive material to maximize their cutting strength. The teeth are coaxially mounted such that their outer peripheral surfaces 25 are equidistant from the blade's rotational axis 26. Thus, when the cutting blade engages a work 27 during cutting, the peripheral teeth surfaces 25 evenly come into contact with the work.

However, with such an arrangement, the leading edges 28 of the teeth tend to wear faster than the central portions. Thus, as seen in the two dot chain lined in Figure 11, the cutting surfaces are rounded thereby reducing both the efficiency and accuracy of the cutting action.

One prior art attempt to solve such wear problems is disclosed in U.S. Patent No. 3,162,187. Specifically, a reinforcing member is provided as a base for a pair of diamond impregnated cutting segments. The cutting segments are fixed to the reinforcing member such that a gap is formed in the central portion of the outer peripheral surface of each segment. The gap decreases the effective cutting area of the outer segment which is asserted to improve cutting efficiency. Additionally, it is suggested that the geometry of the reinforcing member may be varied to further improve the cutting efficiency. However, the only gaps contemplated in the aforementioned patent are formed in the central portion of each cutting segment. Thus, they do not reduce wear on the outer peripheral surfaces of the cutting segment to the desired extent.

Another prior art diamond saw blade design is disclosed in U.S. Patent No. 4,461,268. As described therein, either a continuous or a segmented blade may provided with diamond impregnated cutting segments having corrugations on each side. However, such blades are relatively difficult to manufacture.

SUMMARY OF THE INVENTION

Accordingly, it is a primary objective of the present invention to provide a cutting tooth structure for rotary cutting blades that has increased wear resistance.

To achieve the foregoing and other objects and in accordance with the purpose of the present invention, a rotary cutting blade having an improved cutting tooth structure is provided. The cutting blade includes a disc shaped blade body having an axis and a circumferential surface. A plurality of abrasive impregnated cutting teeth are secured to the circumferential surface of the blade body. Each cutting tooth has a substantially arcuate outer peripheral surface with a leading cutting edge. A first side surface of each tooth is substantially flat while an opposing second side surface has a plurality of grooves cut into the tooth. The grooves are arranged to intersect the tooth's peripheral surface. Thus, the grooves cooperate with the leading edge to provide a plurality of cutting surfaces on each tooth. The teeth are then arranged successively along the circumferential surface of the blade such that their respective grooved surfaces alternately face in opposing directions.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of the present invention that are believed to be novel are set forth with particularity in the appended claims. The invention, together with the objects and advantages thereof, may best be understood by reference to the following description of the presently perferred embodiments together with the accompanying drawings in which:

FIGURE 1 is a side view of a rotary cutting blade in accordance with the present invention.

FIGURE 2 is a sectional view taken along lines II-II in Figure 1.

FIGURE 3 is a diagramatic perspective view of a tooth surface for use on the blade shown in Figure 1.

FIGURE 4 is a diagramatic end view showing the outer phripheral sufaces of a pair of successive teeth from FIGURE 1.

FIGURE 5 is a side view of an alternative tooth arrangement featuring shortened grooves.

FIGURE 6 is a side view of a tooth arrangement sfeaturing slanted grooves.

FIGURE 7 is a side view of a rotary cutting blade in accordance with another embodiment of the invention.

FIGURE 8 is a diagramatic side view of a tooth having grooves.

FIGURE 9 is a diagramatic side view of a tooth having grooves of varying width.

FIGURE 10 is a partial side view of a prior art rotary cutting blade.

FIGURE 11 is a partial sectional view of the prior art blade shown in Figure 10.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

As illustrated in the drawings, a preferred embodiment of the present invention will be described in detail referring specifically to Figures 1 to 4.

As shown in Figures 1 and 2, the rotary cutting blade includes a disc shaped main body 1 formed of a hardened steel. A plurality of notches 2 are formed along the periphery of the main body 1 at substantially constant intervals. Thus, a land 3 is defined between each pair of successive notches 2.

A plurality of arcuate shape teeth segments 4 are individually fixed to the lands such that each tooth is mounted to a single associated land 3. A wide variety of conventional processes, including brazing, laser welding, sintering or the like may be utilized to fix the segments 4 to the land 3. By way of example, the segments 4 may be formed of a sintered alloy having an abrasive powder mixed therein of bronze, cobalt copper, tungsten and the like. Most commonly, diamond powder is used as the abrasive material. The sintered segments 4 have sufficient hardness to prevent damages thereto during cutting. Although the actual number of teeth utilized may vary widely depending upon the desired cutting characteristics, an even number of teeth are preferably provided. In the embodiment shown in Figure 1, 12 teeth are used.

As shown in Figures 3 and 4, one side surface (referred to as the first side surface hereinafter) 5 of each segment 4 is substantially flat. A plurality (four in this embodiment) of grooves 8 are formed on the opposing side surface 6.(referred to as the second side surface hereinafter)

The grooves 8 extend from the outer peripheral surface 7 of each segment 4 to an inner peripheral surface thereof in the radial direction. The grooves 8 have the same width W and are formed in parallel with one another. The depth of the grooves 8 is arranged so that they penetrate approximately half way through the teeth such that the bottom surfaces 9 of the grooves 8 are located substantially in the middle (widthwise) of each segment 4.

As shown in Figure 1, the segments 4 are arranged such that the grooved surfaces of sequential segments alternate between the left and right sides of the blade.

When the segments 4 are fixed to the blade body 1, the side surfaces 5 and 6 of the various segments 4 are arranged to define two parallel planes that orthogonally cross an axis 11 of the main body 1. Thus, the respective bottom groove surfaces 9 are also arranged to substantially define a plane that orthogonally crosses the axis 11. In addition, the outer peripheral surfaces 7 of the segments 4 are arranged cylindrically about the axis 11.

Operations of the described blade will now be explained.

As shown in Figure 2, the blade is fitted to a cutting saw or grinder or the like (not shown). When a work is to be cut and machined by means of the foregoing rotary cutting blades, the blade is rotated at a high speed and the blade is brought into contact with the work 10 to be machined. The leading edge of each segment together with the trailing edges of each groove cooperates to provide a plurality of cutting surfaces on each segment.

Figure 4 is a diagramatic end view showing the outer peripheral surfaces 7 of a pair of the successive segments 4. As seen in that Figure, the symbol A represents the length of an outer peripheral edge of the first side surface 5, B represents the length of a central portion passing through the grooves 8, and C represents the commulative outer peripheral edge of the second side surface 6. Together, A, B, and C are indicative of the blade's effective cutting length since A, B, and C are all actually involved in cutting. The first side surface 5 is flat and four grooves 8 are formed on the second side surface 6, so that a relationship expressed as a formula,

$B = C = A - 4W$,

can be obtained.

Moreover, in this embodiment, there are even number (twelve) of the segments 4, and the segments 4 are arranged on the outer peripheral surface of the main body 1 so that the flat first side surface 5 and the second side surface 6 having the grooves 8 are located alternatively. Therefore, taking two successive segments 4 as one unit for example, the effective cutting length at edges of the outer peripheral surfaces 7 satisfys the following formula at each side surface;

$A + C = A + (A - 4W) = 2A - 4W.$

The effective cutting length of the central portion of the outer peripheral surfaces 7 of the segments 4 satisfies the formula,

28 = 2(A - 4W) = 2A - 8W.

This means that the effective cutting length of the central portion of the outer peripheral surfaces 7 of the segments 4 always becomes shorter by 4W than the effective cutting length of the side surface 5 or 6.

Thus, when a material 10 is cut and machined by the rotary cutting blades of this embodiment, the central portions of the outer peripheral surfaces 7 of all the segments 4 come to contact with the material 10 with shorter effective cutting length than both the edges.

Accordingly, when the segments 4 wear after a long term application, the central portions of the outer peripheral surfaces 7 abrade as much as the edges thereof. Therefore, an advantage of the present design over the prior art is that the outer peripheral surfaces 7 of the segments 4 tend to wear more evenly. Consequently, the cutting efficiency and cutting accuracy of the rotary cutting blades can be improved.

In the foregoing embodiment, the grooves 8 extend from the outer peripheral surfaces 7 of the segments 4 all the way down to the inner peripheral surface thereof in the radial direction. However, as shown in Figure 5, the grooves 8 can be formed so that the grooves 5 shortly extend only a portion of the tooth's height. In addition, as shown in Figure 6, the grooves 8 can be formed so that the grooves 8 slant relative to the radial direction.

In the foregoing embodiment, the number of the segments 4 fixed to the main body 1 is twelve. However, as shown in Figure 7, the number of the segments 4 can be changed, for example, six or the like. Best results are obtained when an even number of segments are used.

Moreover, in the foregoing embodiment, the number of the grooves 8 of each segment 4 is four. However, as shown in Figure 8, the number of the grooves 8 can be changed as well. By way of example, five or the like grooves may be cut into each segment.

Furthermore, in the foregoing embodiment, each groove 8 is formed in a channel shape and the width W of the various grooves 8 are all equal. However, as shown in Figure 9, the grooves 8 can be formed so that they have different widths and are arranged alternatively.

Although only one embodiment of the present invention has been described herein, it should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms without departing from the sprit or scope of the invention. Therefore, the present examples and embodiments are to be considered as illustrative and not restrictive and the invention is not to be limited to the details given herein, but may be modified within the scope of the appended claims.

Claims

1. A rotary cutting blade including a disc shaped blade body (1) having an axis (11) and a circumferential surface characterized by:
a plurality of abrasive impregnated cutting teeth (4) secured to the circumferential surface of the blade body (1), each said cutting tooth (4) including a substantially arcuate outer peripheral surface (7) having a leading edge, a first side surface (5) that is substantially flat and a second side surface (6) having a plurality of grooves (8) that intersect the peripheral surface (7), the leading edge and said grooves cooperating to provide a plurality of cutting surfaces on each said tooth; and
wherein the teeth (4) are arranged successively along the circumferential surface of the blade such that their respective grooved surfaces alternately face in opposing directions.

2. A rotary cutting blade as recited in Claim 1 wherein:
the blade body (1) is a segmented saw blade having a plurality of notches (2) and lands (3) successively arranged along its periphery, the lands being defined between successive notches (2); and
each said land (3) supports a single tooth (4).

3. A rotary cutting blade as recited in Claim 1 wherein the blade body (1) is a continuos saw blade.

4. A rotary cutting blade as recited in any of the preceeding claims wherein the grooves (8) extend radially through the teeth (4).

5. A rotary cutting blade as recited in any of claims 1 to 3 wherein the grooves (8) are slanted relative to the radial direction.

6. A rotary cutting blade as recited in any of the preceeding claims wherein the grooves (8) within each tooth (4) have different widths.

7. A rotary cutting blade as recited in any of the preceeding claims wherein the impregnated abrasive materials are diamonds.

8. A rotary cutting blade as recited in any of the preceeding claims wherein the grooves (8) extend the entire height of the cutting teeth (4).

9. A rotary cutting blade as recited in any of the claims 1-7 wherein the grooves (8) extend only a portion of the height of the cutting teeth (4).

Fig.1

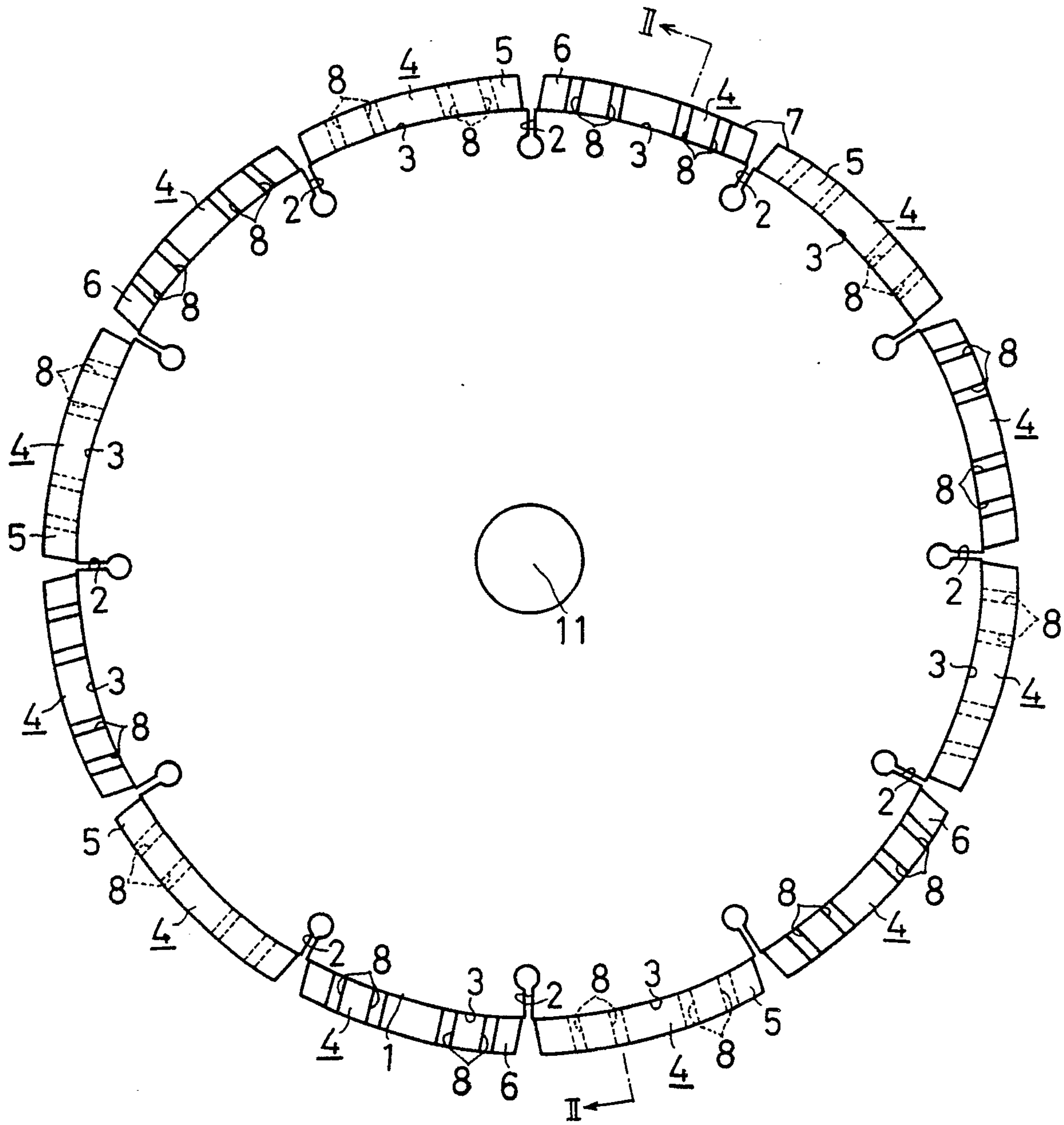


Fig.2

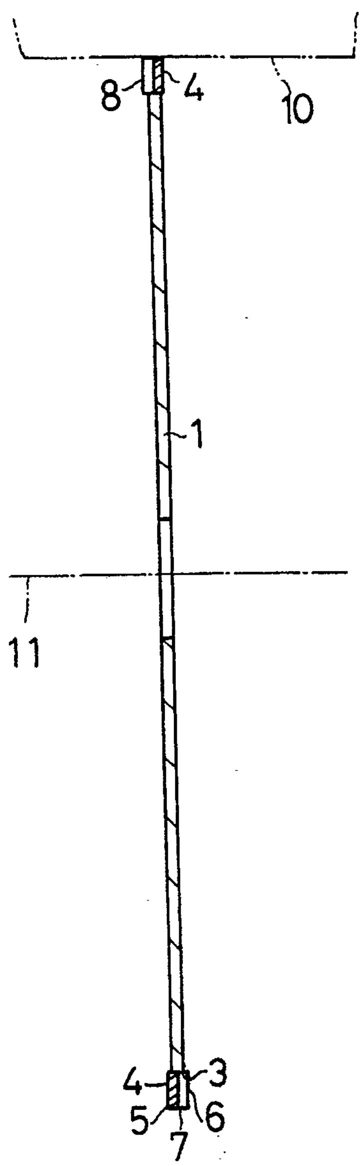


Fig.3

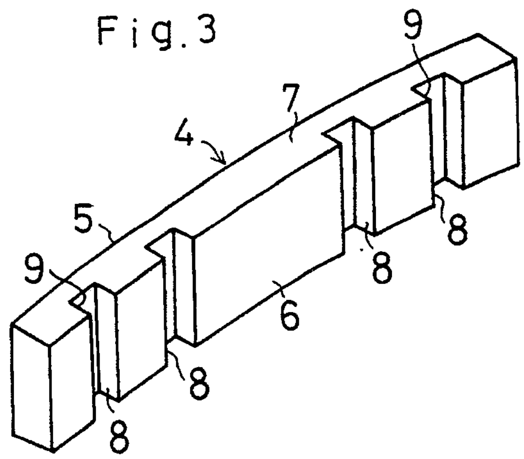


Fig.4

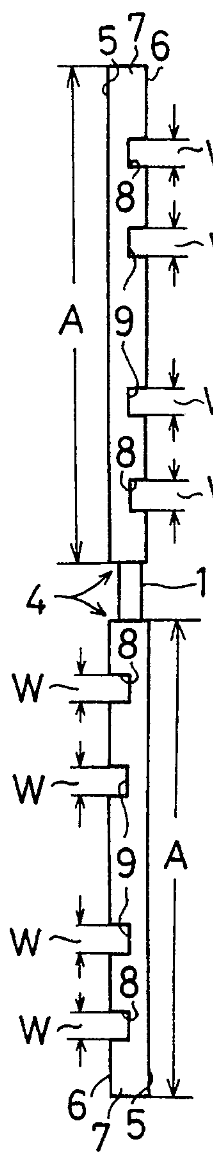


Fig.5

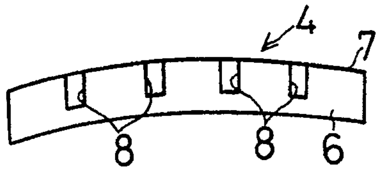


Fig.6

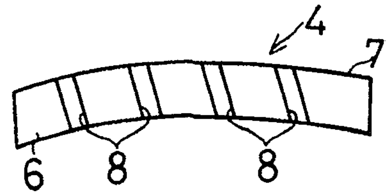


Fig.7

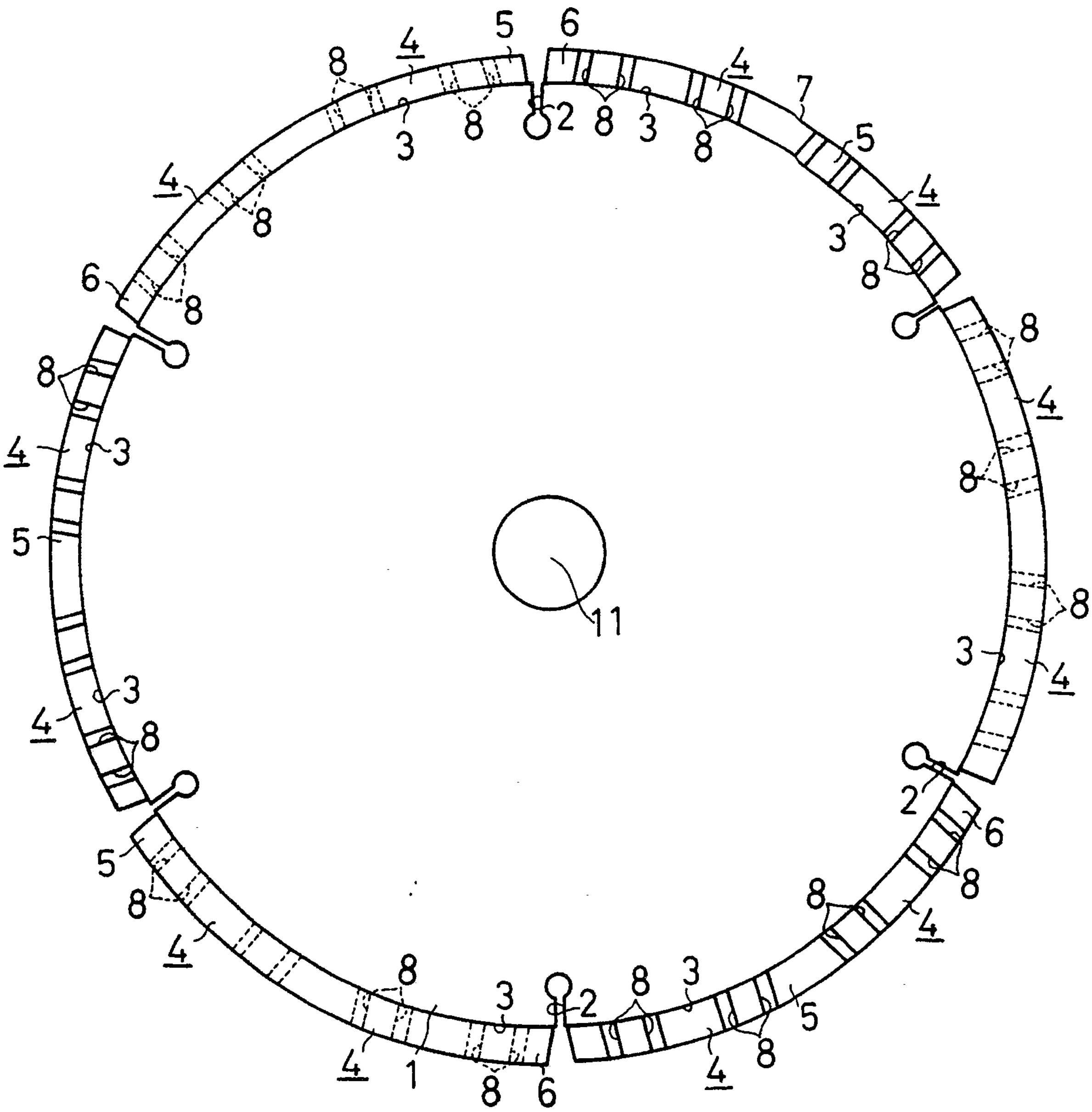


Fig.8

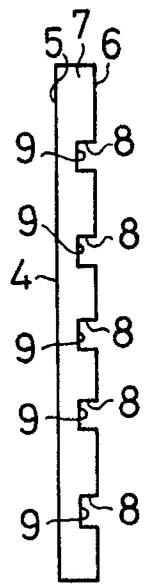


Fig.9

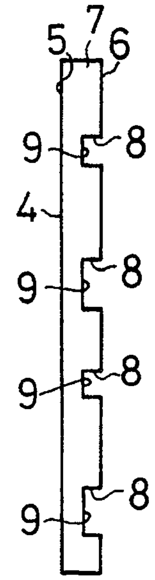


Fig.10 (Prior art)

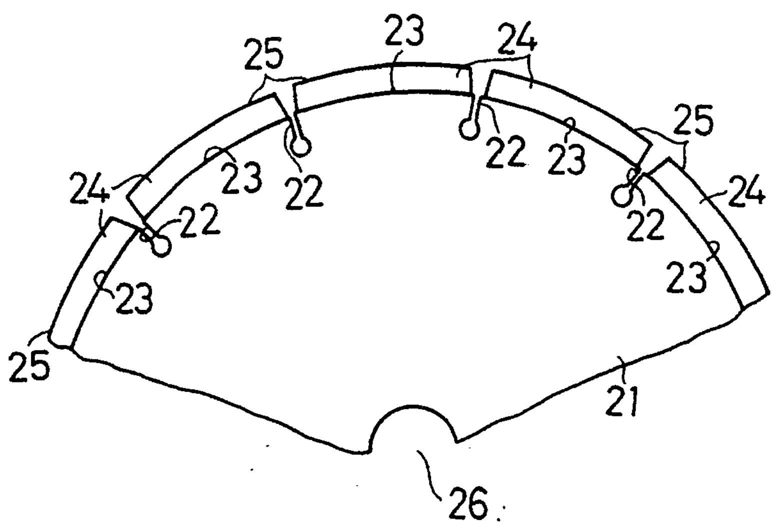


Fig.11 (Prior art)